SECTION 23 51 00
BREECHINGS, CHIMNEYS, AND STACKS

SPEC WRITER NOTES:
1. Delete between //---// if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
2. This section does not include free-standing chimneys.

PART 1 – GENERAL:

1.1 DESCRIPTION:
This section specifies flue gas exhaust system and all accessories from the boiler outlet to the stack outlet to the atmosphere. Flue gas recirculation (FGR) ductwork (if required by burners furnished) is also specified.

1.2 RELATED WORK:
A. Section 07 60 00, FLASHING and SHEET METAL: Roof Penetrations.
B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS,
C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
D. Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT.
E. Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION.
F. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS. Requirements for commissioning, systems readiness checklists, and training
//G. Section 23 52 39, FIRE-TUBE BOILERS: Economizers//
//H. Section 23 52 33, WATER-TUBE BOILERS: Economizers//
//I. Section 23 09 11, INSTRUMENTATION and CONTROL FOR BOILER PLANT: Boiler Draft Control System.//

1.3 QUALITY ASSURANCE:
A. Provide scale drawings showing nominal dimensions and weight of the systems.
B. Boiler and burner manufacturer shall review complete system from boiler flue gas outlet to stack outlet to atmosphere and advise the Government of any changes required to meet boiler and burner performance requirements. Note the altitude of plant site.
C. If a double wall, factory-fabricated, positive pressure breeching and stack system is provided, the manufacturer shall completely engineer the entire system and provide all components. Manufacturer’s representative shall provide installation instructions prior to start of construction, train the installers and certify in writing to the Resident Engineer...
(RE) that the entire installation complies with the official standards of the manufacturer and with the project specifications.

D. Flue gas recirculation ductwork shall be designed and provided by the burner manufacturer.

E. Conform to NFPA 54 and NFPA 31 for installation of fuel burning equipment and appliances.

1.4 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Design, materials, weights, construction, pressure and temperature limitations of breeching and stack systems, flue gas recirculation system. //Seismic design data. //

C. Drawings showing all components, system arrangement and dimensions.

D. Design, construction, allowable movements, movement forces, pressure and temperature limitations of expansion joints.

E. Damper design, construction, pressure and temperature limitations, pressure loss at design flow, and leakage of closed damper.

F. Support designs, locations and loads for entire assembly. //Seismic design data. //

G. Written statement from boiler/burner manufacturer that the design of the system is satisfactory to achieve the required boiler/burner performance.

1.5 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Institute of Steel Construction (AISC):
   Steel Construction Manual, Thirteenth Edition

C. ASTM International (ASTM):
   A36/A36M-08 ............ Standard Specification for Carbon Structural Steel
   A307-07b ............... Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
   A563-07a ............... Standard Specification for Carbon and Alloy Steel Nuts
   A568/A568M-09a ....... Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements For

D. American Welding Society (AWS):
D1.1/D1.1M-2010 ........ Structural Welding Code-Steel

E. Manufacturer’s Standardization Society of the Valves and Fittings Industry (MSS):

F. National Fire Protection Association:
NFPA 54-2006 ........... National Fuel Gas Code
NFPA 31-2006 ........... Standard for the Installation of Oil-Burning Equipment

PART 2 – PRODUCTS:

2.1 BREECHING, STACKS, FGR DUCTWORK:

SPEC WRITER NOTES:
1. Coordinate the breeching and stack design (diameter and height) with the draft requirements of the boiler/burner. The contract drawings must show breeching and stacks in plan and sections and show diameters and heights.
2. The stack height must be sufficient to avoid flue gas being entrained into the boiler room make-up air or impinging on nearby buildings.
3. Where multiple boilers are connected to a common breeching and stack, the design should be based on boilers operating at the required steam output to serve peak load conditions plus a standby boiler in the pre-purge cycle. In this situation, the media in the breeching and stack is a mixture of hot flue gas and relatively cool purge air.

A. Refer to drawings for arrangement and dimensions, except FGR ductwork shall be designed by the burner manufacturer. Connections to boilers and economizers must comply with the written recommendations of the boiler and economizer manufacturers. Ninety-degree tee sections are not permitted. Intersections must be made with lateral tees.

SPEC WRITER NOTE: Add wind-loading information. Edit out seismic requirements in non-seismic zones.

B. Service: Design for continuous 315 °C (600 °F), 12 kPa (50 inches WC) positive and negative internal pressure, wind-loading for outside stacks. //Design system and supports for seismic loads in accordance with Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//
SPEC WRITER NOTES:
1. Only UL-listed pre-engineered double-wall systems should be utilized in the building beyond the perimeter of the boiler plant.
2. Select pre-engineered, pre-fabricated double-wall system (Par. C) or custom designed single wall system (Par. D) for the boiler plant. Design details for the custom-designed single wall system must be shown on the drawings.

C. Pre-engineered, Pre-Fabricated, Double-Wall System:
1. Complete factory-built system, all components and installation engineered and provided by manufacturer of system.

SPEC WRITER NOTE: Allow air space with no insulation on outside stack only if the stack gas cooling and consequent reduction in draft will allow specified burner performance.

2. Provide double wall metal stacks, tested to [UL 103] [UL 127] [UL 641] and UL listed, for use with building heating equipment, in compliance with NFPA 211.
3. Corrosion-resistant steel, double-wall, circular cross section, positive pressure, blanket insulation between walls. //For stack sections outside the building, air space with no insulation between walls is allowed.//
4. Factory-built standard sections, connected in the field with joining system designed and provided by system manufacturer. Designed to be pressure and vacuum-tight, no deformation, at the service conditions specified.
5. System manufacturer’s engineered support system, attached to structural members of the building, with expansion joints between rigid supports. Thermal expansion shall be handled by expansion joints and variable spring hangers. Thermal expansion and weight of system shall not impose loads in excess of that allowed by manufacturer of boiler, economizer, or any other equipment, or exceed capabilities of building structure. Spring hangers shall conform to MSS SP-58, Type 51, variable spring.

SPEC WRITER NOTE: Specify UL-listing and clearances to combustibles and non-combustibles only if necessary because of the location of the stack or breeching.
6. UL-listed for _____mm (______ inches) clearance to combustible materials and _____mm (______ inches) clearance to non-combustible materials. //

SPEC WRITER NOTE: Specify 304 stainless steel for natural gas and No. 2 oil burner fuels. Specify 316 stainless on heavy fuel oil (No. 4, 5, 6).

7. Inner Wall: Stainless steel, Type // 304 // 316 //, 0.9 mm (0.035-inch) minimum thickness for diameters 900 mm (36 inches) and smaller and 1.2 mm (0.048 inches) minimum thickness for diameters greater than 900 mm (36 inches) and 1200 mm (48 inches) and less.

8. Outer Wall: Aluminized or galvanized steel except // 304 // 316 // stainless steel outside of building, 0.6 mm (0.025 inch) minimum thickness for inner wall diameter 800 mm (32 inches) and less, 0.9 mm (0.034 inch) minimum thickness for inner wall diameter over 800 mm (32 inches) and 1200 mm (48 inches) and less.

/9. Uninsulated Air Space between Inner and Outer Walls (Outside the Building Only): 25 mm (one inch) minimum. //

10. Insulation Between Walls: Fiberglass or mineral wool, 315 °C (600 °F). Minimum thickness 50 mm (2 inches).

11. Bands for Joining Sections: Same material as section being joined. Utilize sealant provided by system manufacturer.

12. Roof and wall penetrations shall be manufacturer’s standard ventilated thimble. Conform to Section 07 60 00, FLASHING and SHEET METAL.

13. Stack Outlet: Provide as shown, double cone rain cap or other type termination designed by manufacturer of the stack system.

14. Drain Section: Provide inside building below roof to drain rain water from stack. Extend drain pipe to floor drain.

15. Guys: Provide stack guy wires above roof, with spring-loaded tensioners, in accordance with printed instructions of stack manufacturer.

D. Custom-Designed, field-fabricated, steel single wall system:

1. Breeching and stack walls, carbon steel, ASTM A568, thickness 3.4 mm (0.1345 inch).

2. Fabricate in welded sections with angle terminations for bolted connection of sections. Shapes and plate shall be ASTM A36.

3. Welding shall comply with AWS D1.1.

5. Provide 3.2 mm (1/8 inch) thick high temperature, non-asbestos gaskets between sections.


7. Provide angle clips for attachment of insulation.

8. Roof penetrations shall conform to Section 07 60 00, FLASHING and SHEET METAL.

9. Rain cap shall be double cone arrangement, welded, supported by angles.

10. Support with rigid and spring supports attached to the building structure. Supports shall be designed to completely support the system without overloading the connecting equipment or the building structure. Thermal expansion shall be accommodated by expansion joints and MSS SP-58, Type 51 variable spring hangers (if necessary).

11. Provide guy wires on stacks with spring-loaded tensioners as shown on the drawings.

12. Clean all surfaces of rust, mill scale, and apply prime coat of heat and corrosion resistant paint. Apply finish coats of heat and corrosion-resistant paint to all exposed uninsulated surfaces. Select paint system compatible with maximum surface temperature. Refer to Section 09 91 00, PAINTING.

SPEC WRITER NOTES: Provide outlet dampers and draft control system only on boilers that are connected to a common breeching and tall stack or chimney.

2.2 BOILER OUTLET DAMPERS AND ACCESSORIES

A. Type: Multi-blade, opposed horizontal blades, automatically controlled. Open-shut operation. Also, modulating operation on systems requiring automatic draft control. Locate at the outlets of the boilers. Boiler outlet draft control is specified in Section 23 09 11, INSTRUMENTATION and CONTROL FOR BOILER PLANT.

B. Service: Design for 315 °C (600 °F), 1.2 kPa (5 inches W.C.) positive and negative pressure. Maximum leakage, when closed, shall be ten percent of maximum required flow. Maximum pressure loss at maximum boiler steam output, 0.01 kPa (0.05 inches WC).

C. Construction:

4. Linkages: Control arms dowelled to shafts. All control arms linked to drive motor. External to flow stream. All steel construction.

D. Accessories:
1. Interlock Switch Mounting: Rigid mounting located to allow switch to sense damper linkage position. Switch is connected to burner control system specified in Section 23 09 11, INSTRUMENTATION and CONTROL FOR BOILER PLANT
2. Damper Drive Unit: Electric type that shall operate damper without overload. Provide 100 percent duty cycle maintenance-free motors that never overheat or burnout under stalled conditions. Constant speed coordinated with the controlled process so that performance parameters remain within requirements. For systems without draft control, the drive unit shall automatically open damper 90 degrees on boiler purge and firing cycle; close damper on boiler shut down. For systems with draft control, the drive unit shall automatically open damper 90 degrees on boiler purge cycle, position damper as required for proper burner ignition, modulate damper during boiler firing to maintain constant outlet draft, close damper on boiler shut down.

2.3 EXPANSION JOINTS
A. Provide sufficient types, quantities, and locations of expansion joints to completely absorb all thermal expansion of the system without imposing excessive loads on equipment or building structure. Fabric joints shall be used on single-wall stack and breeching system. On factory-fabricated double wall stack or breeching system, use slip-type, bellows-type, or fabric expansion joints engineered by designer of the stack and breeching system.
B. Service: Design for 300 °C (575 °F), 5 kPa (20 inches) WC positive and negative internal pressure, continuous duty.
C. Construction, Fabric Joints:
   1. Fabric: High strength, designed for dewpoint service.
   3. Welded frame, 6 mm (1/4 inch) thick ASTM A568 steel with 100mm (4 inch) minimum flange height, flat-belt design, fabricated by expansion joint manufacturer. Fabric element bolting, 9 mm (3/8 inch) diameter, 150 mm (6 inch) maximum centers.
D. Construction, Factory-Fabricated Double-Wall System Joints:
   1. Materials: Same as factory-fabricated breeching system.
2.4 ACCESSORIES
   A. Drains: Provide threaded pipe connection to allow drainage at all low points and drain connections in stack and breeching systems. Slope piping system to the drain. Pipe size shall be 25 mm (1 inch) minimum.
   B. Instrument Ports: Locate on individual stack or breeching serving each boiler. Locate in non-turbulent zone within 3600 mm (12 feet) of boiler room floor between boiler and economizer (when economizer is provided) or locate accessible from platform. Provide separate ports for the following:
      1. Flue gas oxygen analyzer: Coordinate with analyzer furnished.
      2. Opacity monitor (if required): Coordinate with sensor furnished. Locate downstream from oxygen analyzer.
      3. Stack temperature sensor: Coordinate with sensor furnished.
      4. Draft gauge: 25 mm (1 inch) diameter coupling, plugged.
      5. Test instruments: 25 mm (1 inch) diameter coupling, plugged.
   C. Access Doors: Bolted, gasketed, insulated, with handles. Provide where shown. Minimum opening 400 mm x 400 mm (16 inches x 16 inches).

2.5 TYPE B DOUBLE WALL GAS VENTS
   A. Fabrication: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, tested in compliance with UL 441.

PART 3 - EXECUTION
   SPEC WRITER NOTE: Select Par. 3.1 or 3.2, depending on the type of system specified.

3.1 INSTALLATION - PRE-ENGINEERED, PRE-FABRICATED DOUBLE WALL SYSTEM
   A. Supports: Completely support all systems from the building structure without overloading the building structure or the connected equipment. Support system shall be engineered by the system manufacturer and shall accommodate thermal expansion. //Refer to seismic requirements in Section 13 05 41, SEISMIC RERAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//
   B. Factory-Fabricated Stack or Breeching System:
      1. Install in accordance with manufacturer's printed instructions, NFPA 54 and NFPA 31.
      2. Deliver a copy of the instructions to the RE/COTR prior to commencing the installation.
      3. Representative of manufacturer shall provide field training on all installation techniques to all installers.
   C. Connect 25 mm (1 inch) minimum pipes with ball valves to breeching and stack drains. Extend to floor drain.
D. Boiler or Economizer Outlet Dampers: Locate so that there is no restriction in the flow of flue gas recirculation (if provided).
E. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.

3.2 INSTALLATION - CUSTOM-DESIGNED, FIELD-FABRICATED, STEEL SINGLE WALL SYSTEM

SPEC WRITER NOTE: Verify that supports are shown on the contract drawings.

A. Supports: Completely support all systems from the building structure without overloading the building structure or the connected equipment. Support system shall be as shown on the drawings. //Refer to seismic requirements in Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//
B. Joints: Provide continuous weld between boiler outlet and connecting transition, breeching or stub stack and at connections to economizers, when recommended by manufacturer of economizer or boiler. Securely bolt all remaining joints and provide gaskets rated for service at 315 °C (600 °F).
C. Field-Applied Insulation: Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
D. Connect 25 mm (1 inch) minimum pipes with ball valves to breeching and stack drains. Extend to floor drain.
E. Boiler or Economizer Outlet Dampers: Locate so that there is no restriction in the flow of flue gas recirculation (if provided).
F. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.
G. Install in accordance with NFPA 54 and NFPA 31.

3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

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